

BRADY et al
Application No. 09/936,998
Response to Office Action dated February 22, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in this application.

Listing of Claims:

Claims 1-23 (Canceled).

Claim 24 (Currently Amended): A method of processing image data of a plurality of time-separated images of a non-rigid body to detect movement of the body, comprising the steps of: [[-]]

for each of a plurality of sampling points in each image, calculating and storing a plurality of candidate movements together with the estimated probability of each candidate;

iteratively recalculating for each sampling point the probability of each of the candidate movements ~~movement~~ based on the stored probability of that candidate movement and the probabilities of the candidate movements at neighbouring ~~other~~ sampling points; and

generating from the recalculated probabilities a motion field indicative of the non-rigid body movement,

wherein said step of recalculating comprises:

iteratively selecting each of a plurality of surrounding motion probabilities from the stored probabilities of candidate movements for each of a plurality of the neighbouring sampling points, said selection at each neighbouring sampling point being performed on the basis of the stored probabilities for that sampling point, and

recalculating the probability based on the stored probability of that candidate movement and said plurality of surrounding motion probabilities.

Claim 25 (Canceled).

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Claim 26 (Previously Presented): A method according to claim 24, wherein the sampling points correspond to unit areas containing a set of pixels of the image.

Claim 27 (Previously Presented): A method according to claim 24, wherein the plurality of candidate movements and their probabilities are calculated by calculating a similarity measure indicating the similarity of each sampling point to sampling points in the preceding image, and normalizing the similarity measures to sum to unity, the normalised similarity measures being stored as said probabilities, and the candidate movements are the corresponding vector displacements which map the sampling point to the respective sampling points in the preceding image.

Claim 28 (Currently Amended): A method according to claim 27, wherein the similarity measure is selected from mutual information, normalised mutual information, entropy correlation coefficient and centered cross correlation.

Claim 29 (Currently Amended): A method according to claim 24, wherein the iterative recalculation of the stored probabilities comprises multiplying each stored probability by the product of a selected the stored probability probabilities for each of the neighbouring sampling points.

Claim 30 (Currently Amended): A method according to claim 29, wherein the iterative recalculation of the stored probabilities comprises multiplying each stored probability by the product of the respective maxima of the stored probabilities for the neighbouring sampling points.

Claim 31 (Currently Amended): A method according to claim 29, wherein the iterative recalculation of the stored probabilities comprises multiplying the stored probability for each candidate movement at each sampling point by the product of the respective maxima of the stored probabilities for the neighbouring sampling points, the maxima being weighted according

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to the difference between said candidate movement and the respective stored movements corresponding to the maxima.

Claim 32 (Currently Amended): A method according to claim 31, wherein the weighting is Gaussian.

Claim 33 (Currently Amended): A method according to claim 24, wherein the iterative recalculations of the probabilities for the movements at each sampling point use only movements at neighbouring sampling points which are judged to be similar to the said movements at each sampling point.

Claim 34 (Currently Amended): A method according to claim 33, wherein movements are judged to be similar if the difference in magnitudes of the displacements caused by the movements is less than a preset amount.

Claim 35 (Currently Amended): A method according to claim 24, wherein the number of iterations is set according to the distance between salient points in the image.

Claim 36 (Currently Amended): A method according to claim 24, wherein the motion field is generated by selecting as the movement at each sampling point the candidate movement having the maximum probability after said iterative recalculation.

Claim 37 (Currently Amended): A method according to claim 36, further comprising the step of correcting the plurality of images for the movement by applying thereto a transformation based on the motion field, and then repeating the method of claim 36 ~~13~~ using differently spaced sampling points to generate a new motion field.

Claim 38 (Currently Amended): A method according to claim 37, wherein the transformation is calculated by fitting a parametric transformation to the motion field.

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Claim 39 (Currently Amended): A method according to claim 37, wherein the steps of correcting the plurality of images for the movement and then repeating the method of claim 36 ~~13~~ using differently spaced sampling points, are carried out iteratively with successively more closely spaced sampling points.

Claim 40 (Currently Amended): A method according to claim 24, wherein the images are a sequence of magnetic resonance images of a body taking up a contrast agent.

Claim 41 (Currently Amended): A method according to claim 24, wherein the images are a sequence of magnetic resonance images of a human breast taking up a contrast agent.

Claim 42 (Currently Amended): Apparatus for processing image data of a plurality of time-separated images of a non-rigid body to detect movement of the body, comprising:
calculating means for calculating, for each of a plurality of sampling points in each image, a plurality of candidate movements together with the estimated probability of each candidate;
storage means for storing said candidate movements and estimated probabilities;
recalculating means for iteratively recalculating for each sampling point the probability of each of the candidate ~~movements~~ movement based on the stored probability of that candidate movement and the probabilities of the candidate movements at neighbouring other sampling points; and
motion field generating means for generating from the recalculated probabilities a motion field indicative of the non-rigid body movement,
wherein said recalculating means is adapted to iteratively select each of a plurality of surrounding motion probabilities from the stored probabilities of candidate movements for each of a plurality of the neighbouring sampling points, said selection at each neighbouring sampling point being performed on the basis of the stored probabilities for that sampling point, and to recalculate the probability based on the stored probability of that candidate movement and said plurality of surrounding motion probabilities.

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Claim 43 (Currently Amended): A computer program storage medium readable by a computer system and encoding a computer program for controlling a computer to process image data of a plurality of time-separated images of a non-rigid body to detect movement of the body by a method comprising the steps of: [[-]]

for each of a plurality of sampling points in each image, calculating and storing a plurality of candidate movements together with the estimated probability of each candidate;

~~iteratively~~ recalculating for each sampling point the probability of each of the candidate ~~movements~~ movement based on the stored probability of that candidate movement and the probabilities of the candidate movements at ~~neighbouring~~ ~~other~~ sampling points; and generating from the recalculated probabilities a motion field indicative of the non-rigid body movement,

wherein said step of recalculating comprises:

iteratively selecting each of a plurality of surrounding motion probabilities from the stored probabilities of candidate movements for each of a plurality of the neighbouring sampling points, said selection at each neighbouring sampling point being performed on the basis of the stored probabilities for that sampling point, and

recalculating the probability based on the stored probability of that candidate movement and said plurality of surrounding motion probabilities.

Claim 44 (New): Apparatus configured to perform the method of claim 24.